defect & fault tolerance | in VLSI and nanotechnology systems

Influence of triple-well technology on laser fault injection and laser sensor efficiency

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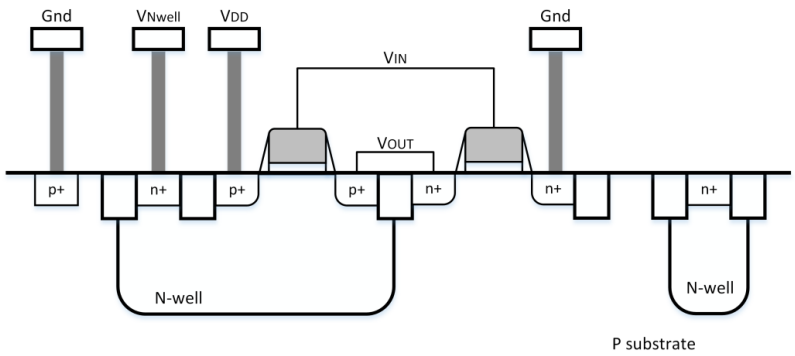
Purpose

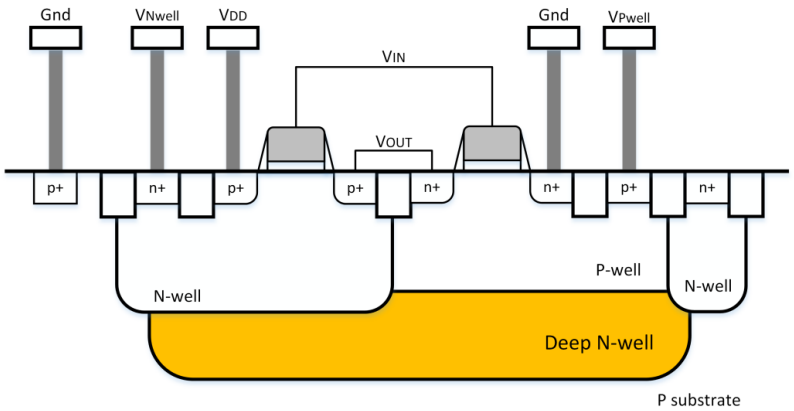
- ***Context***
  - Security robustness comparison in **dual**-well & **triple**-well architecture
- ***Objectives***
  - Laser fault injection limit on Flip-Flops
  - Laser sensor efficiency
- ***Presentation***
  - Architecture
  - Laser Fault Injection
  - BBICS sensor
  - BBICS optimization with the use of Body-Biasing

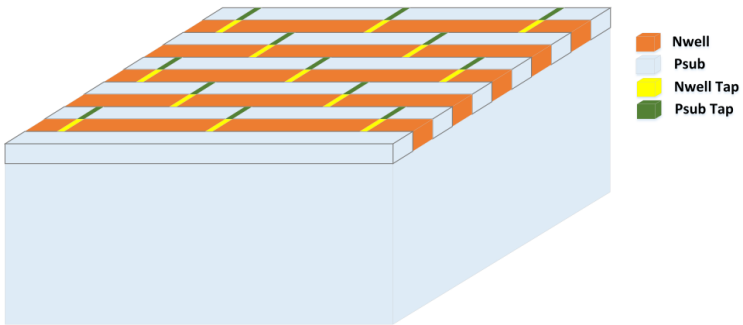
Architecture

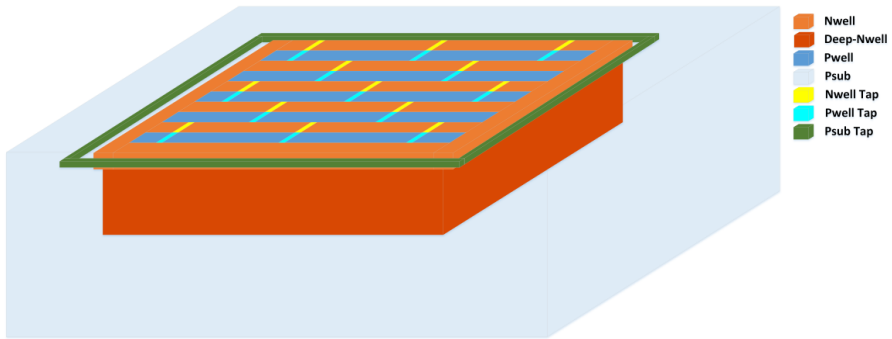
- ***Dual-well***



- ***Triple-well***







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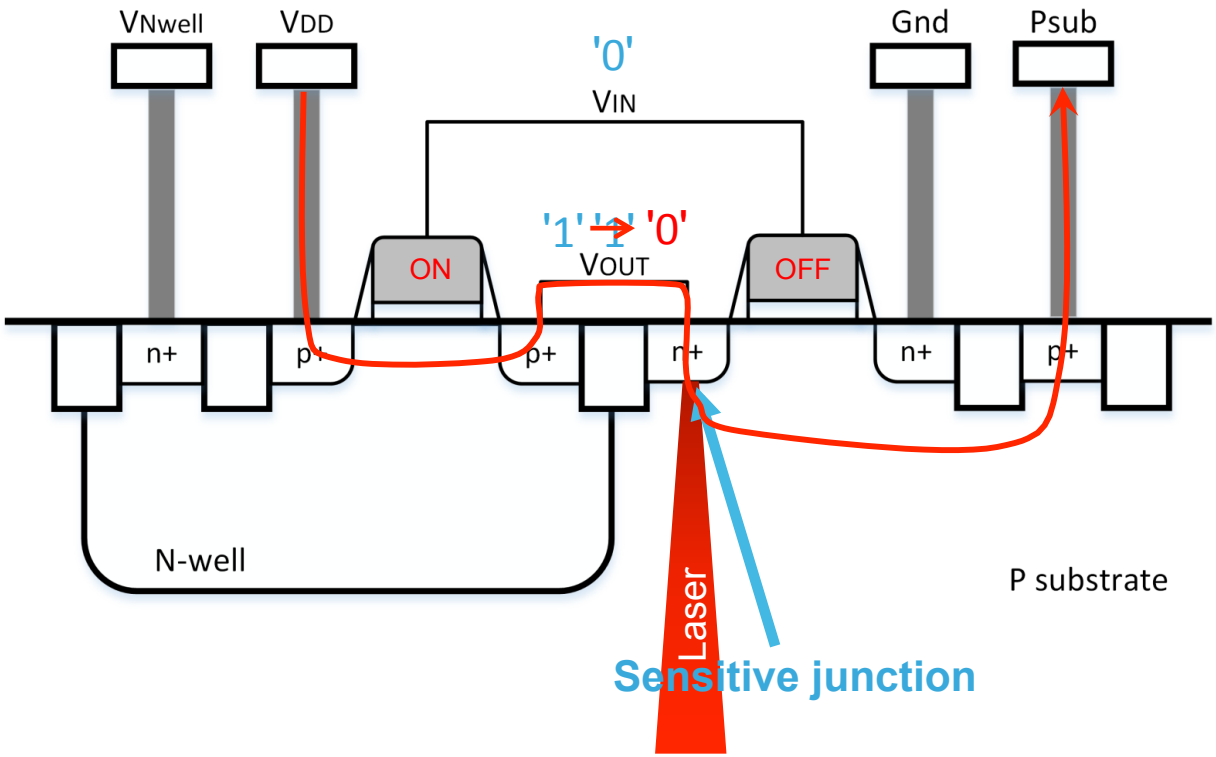
Laser Fault Injection principles

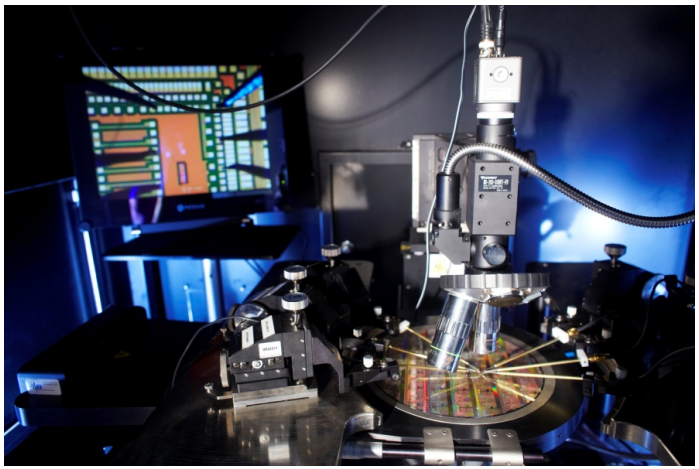


- ***Bit reset:* output from '1' to '0'**
  - Sensitive part: Drain of the NMOS

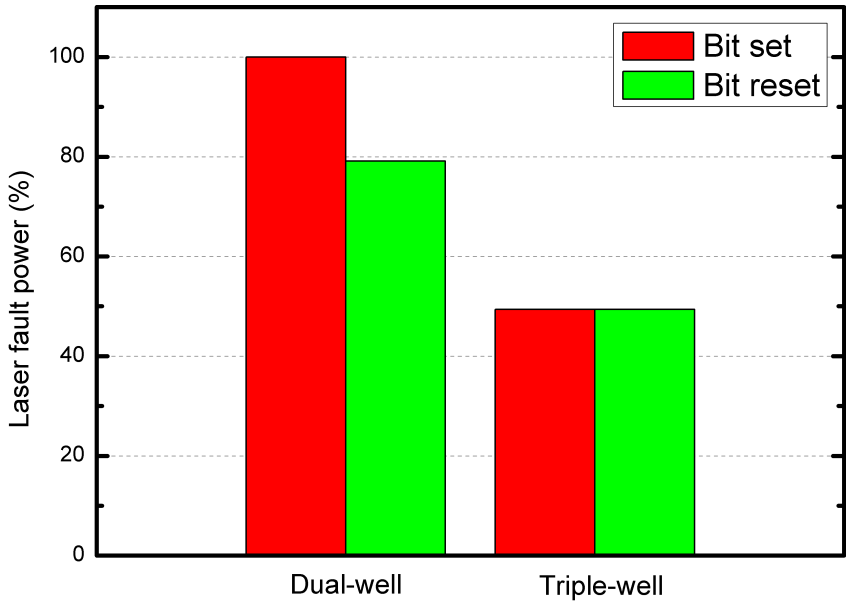
Fault Injection comparison

- ***Laser***
  - Wavelength: 1064nm
  - Pulse duration: 5µs
  - Spot size: 1µm

- ***Device Under Test***
  - CMOS 40nm STMicroelectronics
  - Wafer thickness: 140µm



Flip-flop robustness evaluation



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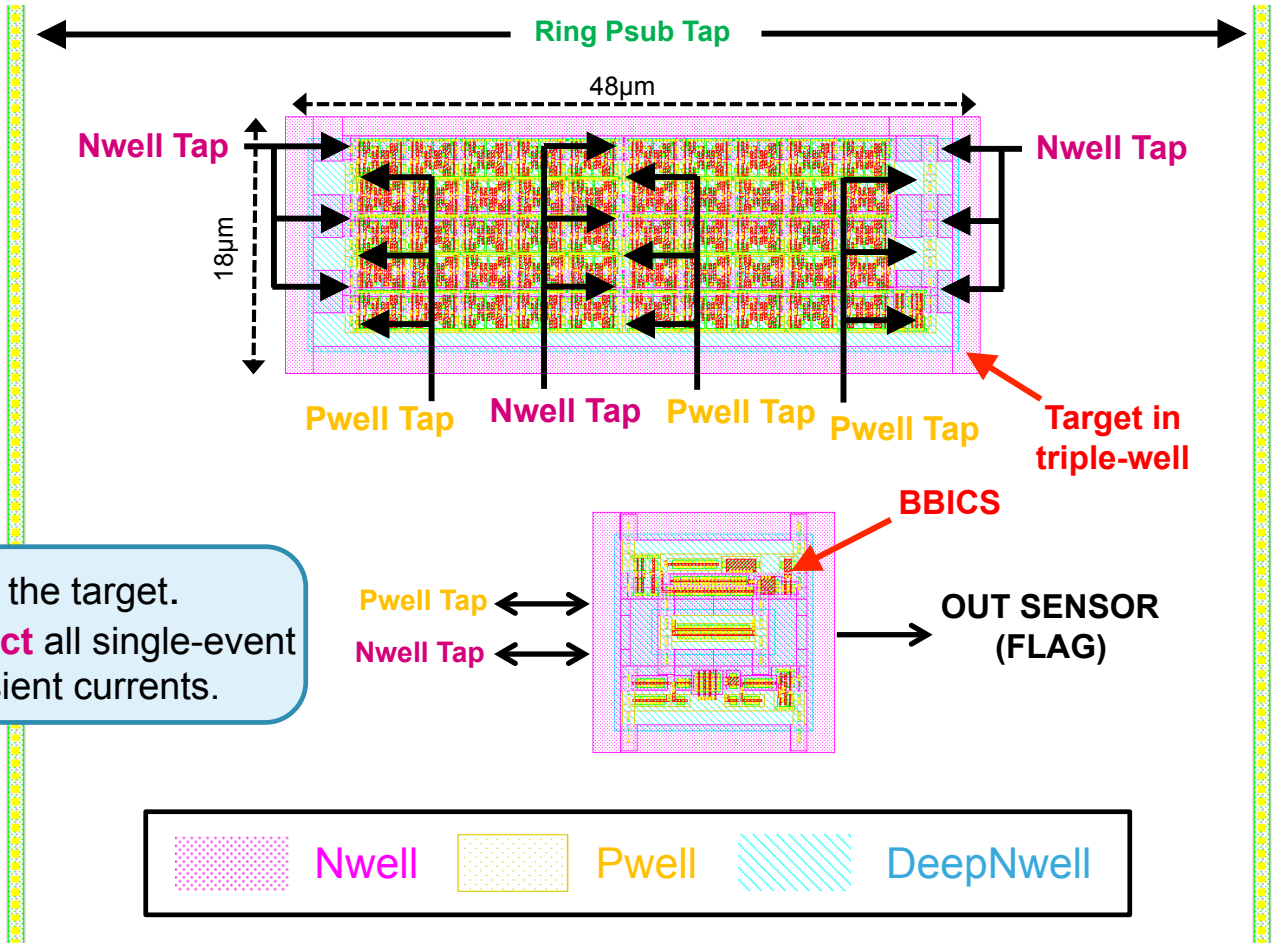
Sensor BBICS

- ***BBICS:*** ***B****ulk* ***B****uilt-****I****n* ***C****urrent* ***S****ensor*



- **Bias** the target.
- **Detect** all single-event transient currents.

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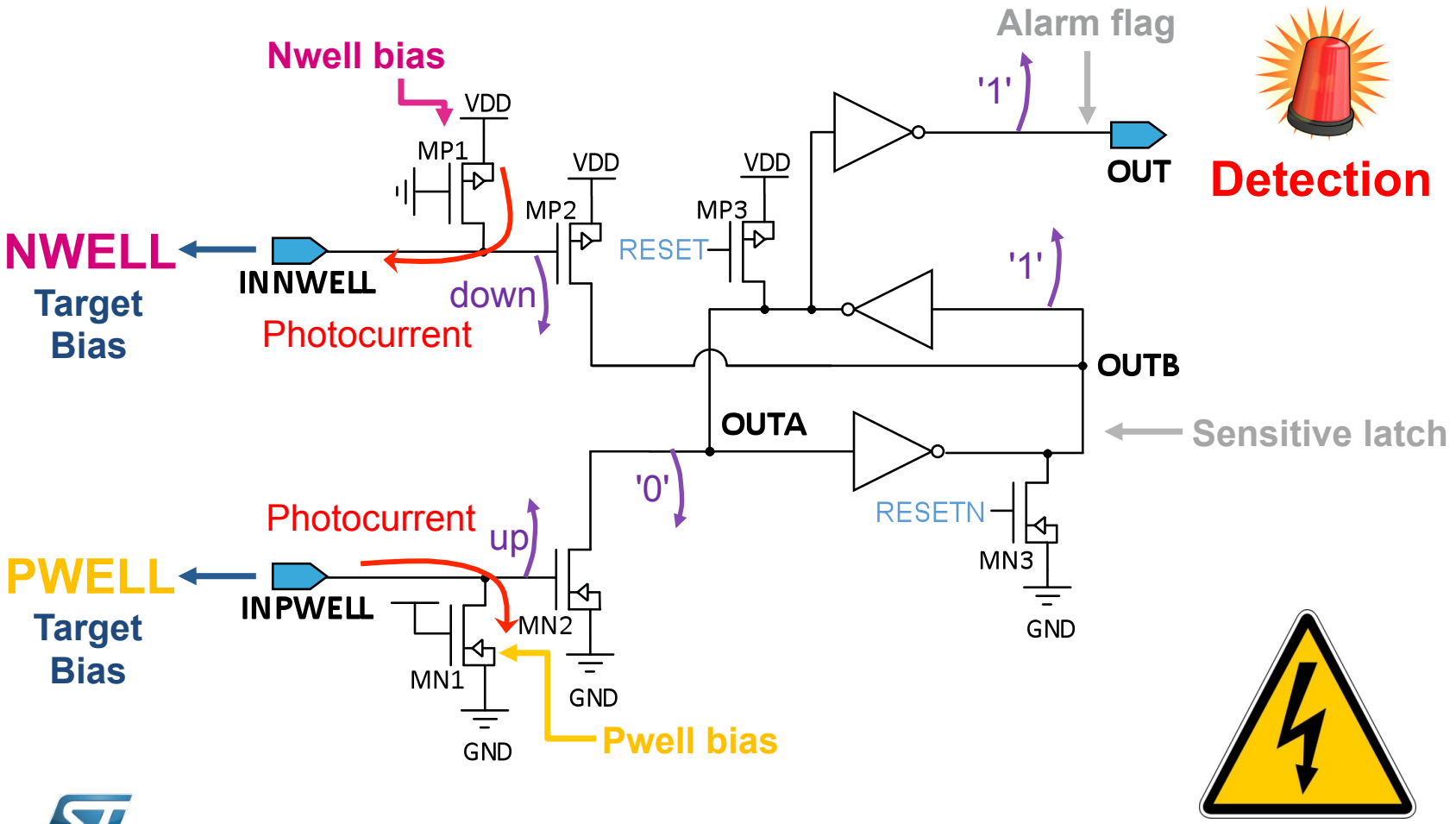
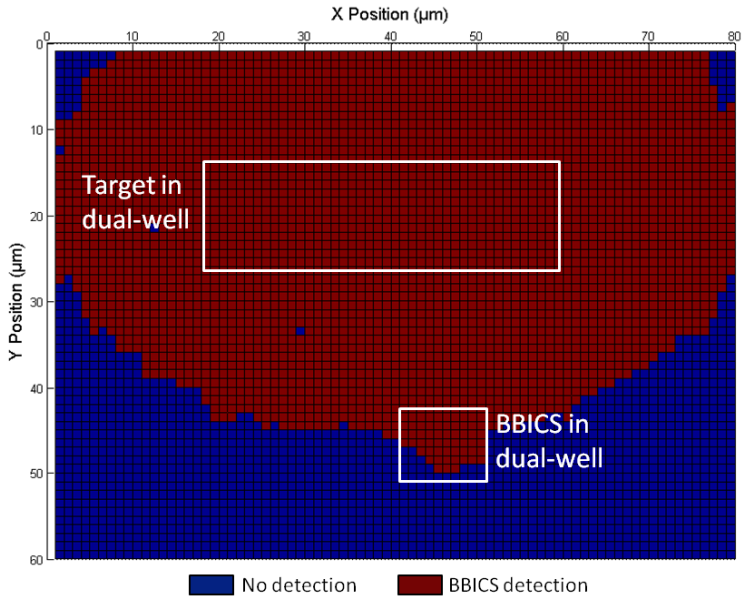
Architecture of BBICS

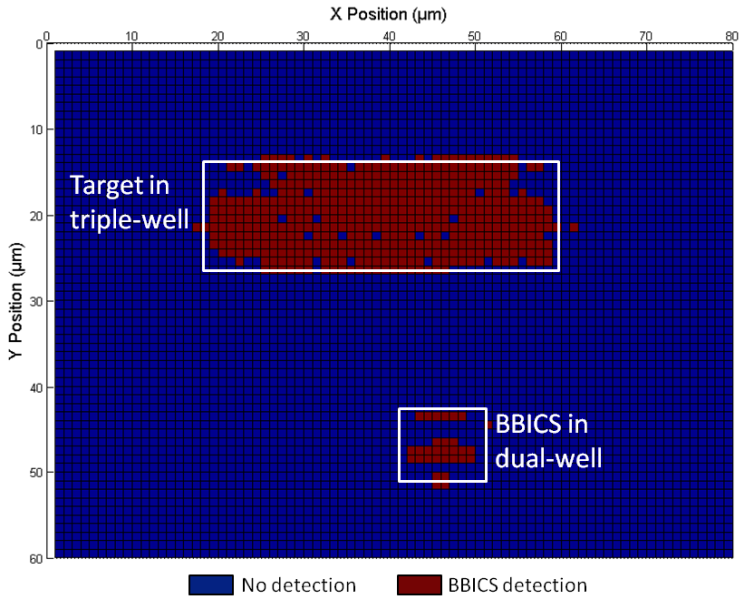


BBICS experiments

- ***Dual-well***



- ***Triple-well***



- ***BBICS coverage***
  - Dual-well >> Triple-well

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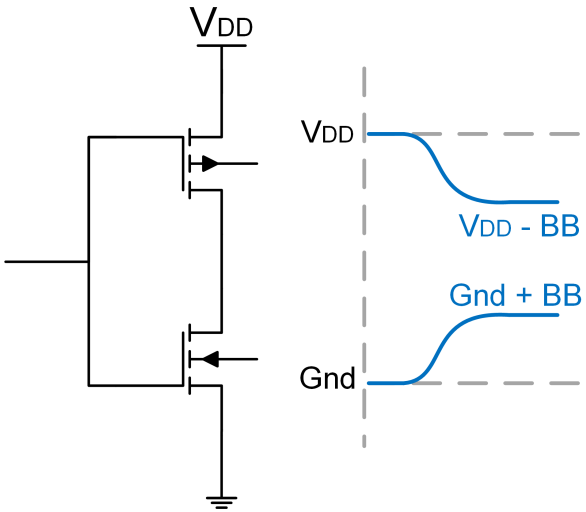
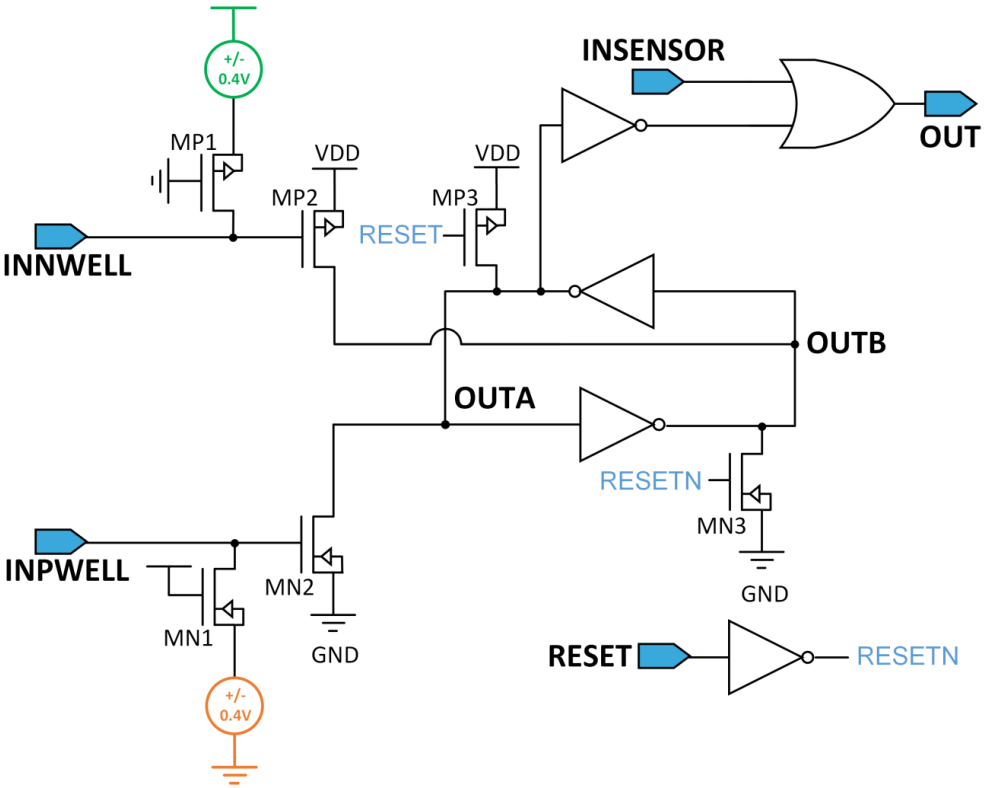
The use of Body-biasing

- ***Low power Body-biasing techniques***



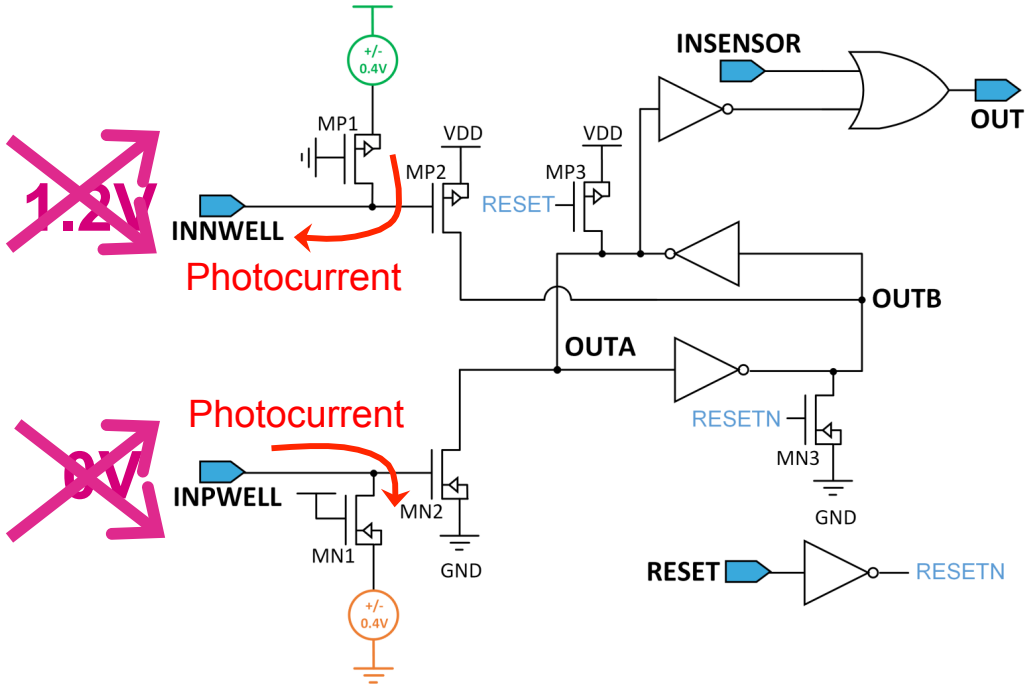
- Reverse Body-Biasing
- ↕ Vth
- ↕ Speed ~~and~~ consumption

- ***BBICS with Body-biasing architecture***



BBICS with Body-biasing Evaluation

Reverse Body-Biasing



Body-biasing	Nwell potential (V)	Pwell potential (V)	DeepNwell Current (µA)	Pwell current (µA)	Laser power (%)
RBB					
No BB					
FBB					

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Conclusion

- ***Results comparison***
  - Security Gate robustness architecture

    Dual-well: **100%** >> **triple**-well: **50%**
  - BBICS limit detection

    Dual-well: **30%** << **triple**-well: **100%**

  - BBICS with Body-biasing

    triple-well: **15%**
- ***Perspective***
  - Silicon evaluation of BBICS with Body-biasing

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Thank you for your attention…
Q & A

Speaker: Nicolas BORREL

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